3.16 GLOBAL CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

A variety of studies have been conducted analyzing global climate change, the effect anthropogenic factors have on climate change, and the potential effects to the region of anticipated future climate change impacts. This section provides the Affected Environment and regulatory context that apply to the key issues that pertain to climate change for this project: greenhouse gas (GHG) emissions and sea level rise/extreme events. The GHG emissions calculations and more detailed regulatory information are provided in Appendix K.

3.16.1 AFFECTED ENVIRONMENT

Climate is the accumulation of daily and seasonal weather events over a long period of time, whereas weather is defined as the condition of the atmosphere at any particular time and place. Climate change refers to the change in long-term average weather conditions and is a global phenomenon (Gutro 2005).

Certain gases in Earth's atmosphere, classified as GHGs, play a critical role in determining Earth's surface temperature. Solar radiation enters Earth's atmosphere from space. A portion of the radiation is absorbed by Earth's surface, and a smaller portion is reflected back toward space as infrared radiation (heat). Infrared radiation is selectively absorbed by GHGs; as a result, infrared radiation released from Earth that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This is known as the "greenhouse effect" and is responsible for maintaining a habitable climate on Earth. Without the naturally occurring GHGs and the greenhouse effect, Earth would not be able to support life as we know it.

However, anthropogenic emissions of GHGs leading to atmospheric levels in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect. This has resulted in a trend of unnatural warming of Earth's atmosphere and oceans, with corresponding effects on global circulation patterns and climate (IPCC 2007). There is international scientific consensus that human-caused increases in GHGs have contributed and will continue to contribute to global climate change, although there is uncertainty concerning the magnitude and rate of the change.

ARB has identified six principal GHGs that contribute to the greenhouse effect: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These six GHGs compose the emissions to be monitored to meet the requirements of AB 32, the Global Warming Solutions Act of 2006. Likewise, EPA's endangerment finding of 2009 covers emissions of the same six GHGs. Water vapor is an important GHG but its concentration depends on temperature and other meteorological conditions; therefore, it is considered a feedback of climate change rather than a direct cause (IPCC 2007).

Carbon dioxide equivalent (CO_2e) is a measurement used to account for the fact that each type of GHG has a different potential to retain infrared radiation in the atmosphere and contribute to the greenhouse effect. Expressing emissions in CO_2e takes the contributions to the greenhouse effect of all GHG emissions and converts them to the equivalent effect that would occur if CO_2 were being emitted. This measurement, known as the global warming potential (GWP) of a GHG, is dependent on the lifetime, or persistence, of the gas molecule in the atmosphere and is generally calculated over a 100-year period. The GWP of the six principle GHGs is shown in Table 3.16-1.

Table 3.16-1
Global Warming Potential of Greenhouse Gases

Greenhouse Gas	Symbol	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	HFC	14–14,800
Perfluorocarbons	PFC	6,500–12,200
Sulfur Hexafluoride	SF_6	23,900

Source: IPCC 2007

The amount of CO_2 in the atmosphere in the past 150 years (the time when anthropogenic GHG emissions increased significantly) has risen from approximately 280 parts per million (ppm) to 390 ppm and is increasing at a rate of approximately 2 ppm per year (NOAA 2012). Although efforts at the international, national, state, and local levels are underway to reduce future emissions of GHGs, some level of climate change has already occurred and additional climate change is predicted for the future, although the extent of future change is uncertain. The change in GHG emissions has led to 1.3°F change in average global air temperature from 1900–2000. The Intergovernmental Panel on Climate Change (IPCC) anticipates that additional increases in atmospheric CO_2 could increase by up to 11.5°F by 2100.

Increased levels of GHGs in the atmosphere not only affect global average temperatures, but climate change models predict changes in temperature, precipitation patterns, water availability, sea levels, and extreme events, such as tsunamis. It is anticipated their impact will vary by region, and these altered conditions may have severe impacts on natural and human systems in California (CalEPA 2010). Sea levels have risen by as much as 7 inches along the California coast over the last century. The state has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year (CNRA 2009). Additional changes related to climate change can be expected by the year 2050 and on to the end of the century:

- California's mean temperature may rise 1.5°F to 5.0°F by 2050 and 3.5°F to 11°F by the end of the century.
- Average annual precipitation may show little change, but more intense wet and dry periods can be expected with more floods and more droughts.
- Flood peaks will become higher and natural spring/summer runoff will become lower.
- Global sea level projections suggest possible sea level rise of approximately 14 inches (36 centimeters) by 2050 and a high value of approximately 55 inches (140 centimeters) by 2100 (CNRA 2009).

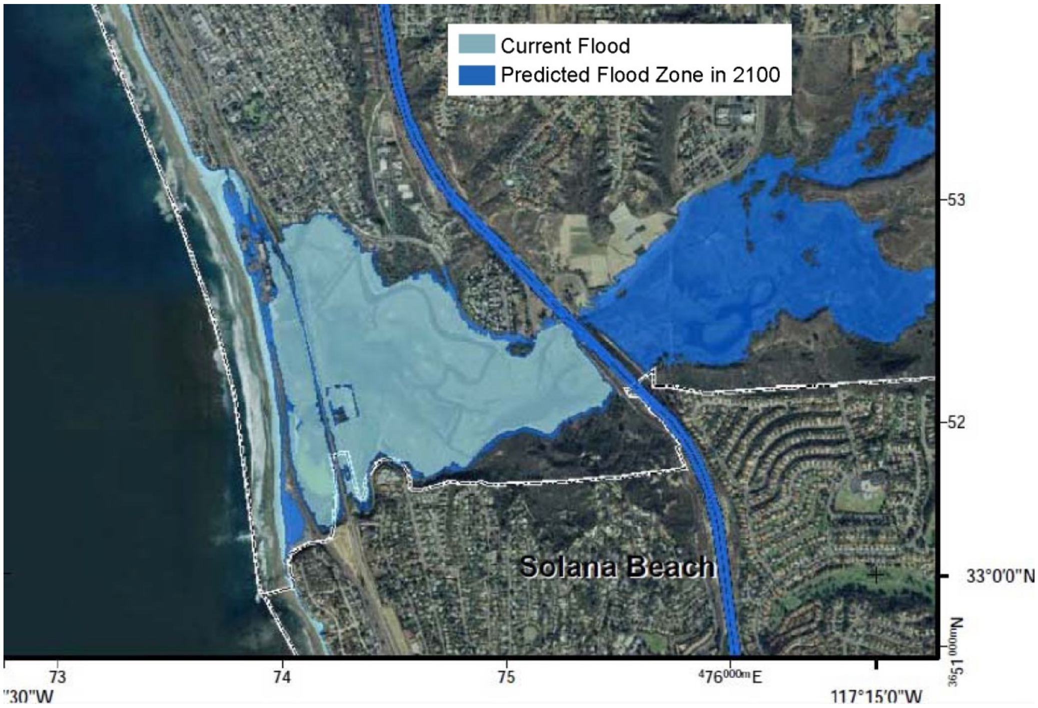
Climate models are used to predict changes in temperature, precipitation, and other effects due to climate change. In the past, models have been reliable on a global scale; more recently, confidence in regional models is increasing (IPCC 2007) and can provide a more localized evaluation of climate change impacts by downscaling global models to specific regions. Downscaling (at the 12-kilometer grid level) has been conducted for California and shows southern coastal areas are likely to experience average temperatures of 2.9 to 3.8°F (1.6 to 2.1° Centigrade) warmer and +3 percent to –24 percent annual precipitation by about 2065 (Cayan et al. 2012). California has created an interactive website called Cal-Adapt to help planners assess regional and local impacts of climate change under different scenarios (http://cal-adapt.org/).

Sea level rise will not be uniform, nor uniformly affect the state's population, infrastructure, and ecosystems. The population vulnerable to a 100-year flood along the Pacific coast in San Diego County will increase by 210 percent with a 55-inch sea level rise, from 3,000 to 9,300 residents (Heberger et al. 2009).

The Pacific Institute has developed a series of maps demonstrating areas at risk in the current 100-year flood zone and with a 55-inch sea level rise (Figure 3.16-1). The map for San Elijo lagoon is presented below; light blue indicates the current 100-year flood zone and dark blue indicates the flood zone under a sea level rise scenario of 55 inches in 2100.

Extreme events that would be exacerbated due to sea level rise include storm surge and tsunamis. As mapped by the California Emergency Management Agency, California Geological Survey, and University of Southern California, the entire coastline in the San Diego region is considered a tsunami hazard area (Department of Conservation 2009). San Elijo Lagoon is also included within this tsunami hazard area, with the tsunami inundation area encompassing the entire central and west basins, as well as the coastal area, of the project study area.

Figure 3.16-1
San Elijo Lagoon Flood Zone (Current and Predicted Sea Level Rise in 2100)



Source: http://www.pacinst.org/reports/sea_level_rise/hazmaps/Encinitas.pdf

3.16.2 CEQA Thresholds of Significance

Greenhouse Gas Emissions

The quantity of GHGs that it takes to ultimately result in climate change is not precisely known; however, a single project would be unlikely to measurably contribute to a noticeable incremental change in the global average temperature. GHG impacts to global climate change are inherently cumulative, and projects should be evaluated through cumulative impacts, since GHG emissions from multiple projects could result in a cumulative impact with respect to global climate change. There are different CEQA and NEPA thresholds of significance for GHG emissions. The thresholds used in this analysis are described in the paragraphs below.

CEQA

ARB and SDAPCD have not established quantitative significance thresholds for evaluating GHG emissions in CEQA analyses. Appendix G of the CEQA Guidelines states that a significant impact related to global climate change and GHG emissions would occur if implementation of the proposed project would:

A. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment

B. Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases

The County of San Diego's Significance Guidelines for Climate Change were developed at the countywide level, and therefore may be applicable to the current project. The County of San Diego has established a threshold of 2,500 metric tons (MT) CO_2e per year as a project-level GHG significance threshold that would apply to construction and operational emissions. The 2,500 MT CO_2e per year threshold is applied to both construction and operational emissions for CEQA analysis.

NEPA

There are no federally-applicable thresholds for the evaluation of GHG emissions. The Council on Environmental Quality (CEQ) guidance proposes 25,000 MT CO_2e per year as a useful indicator to determine whether additional analysis of climate change impacts may be required. Therefore, the threshold of 25,000 MT CO_2e per year will be used to analyze emissions under NEPA.

Sea Level Rise and Extreme Events

Section 15126.2 of the CEQA Guidelines states that "the EIR should evaluate any potentially significant impacts of locating development in other areas susceptible to hazardous conditions (e.g., floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments or in land use plans addressing such hazards areas." In March 2012, the California State Coastal Conservancy (SCC) issued a guidance document for projects funded by the SCC for assessing impacts and vulnerabilities of a project subject to sea level rise and extreme events. The SCC recommends a risk analysis approach to evaluate the ability of a project to adapt or cope with sea level rise over time, including implementation of project design features that would reduce risks.

On November 9, 2011, the Second District Court of Appeals held that a lead agency is not required to analyze the impact of the environment on a proposed project under CEQA (*Ballona Wetlands Land Trust et al. v. City of Los Angeles*). Even though the requirements for analyzing the impact of the environment on a project continue to be litigated, this analysis also includes an evaluation of the project's vulnerability to sea level rise and extreme events for informational purposes only. This approach is consistent with Executive Order S-13-08, which recommends consideration of sea level rise to assess project vulnerability.

3.16.3 ENVIRONMENTAL CONSEQUENCES

Greenhouse Gas Emissions

Lagoon Restoration and Material Disposal

This analysis focuses on the direct and indirect GHG emissions resulting from construction of the project and subsequent maintenance activities, including construction equipment, worker vehicle trips, waste generation, and fuel use and electricity consumption from other equipment. GHG emissions due to the proposed action would be associated with construction and ongoing maintenance. Construction-related emissions would be associated with dredging and vegetation removal equipment, construction vehicles, and employee commute trips. Construction emissions would be temporary and would cease upon completion of the proposed restoration project. Operational emissions would be associated with infrequent maintenance and would primarily involve worker vehicle trips.

Emissions from the operation of diesel-fueled off-road equipment were estimated by multiplying peak daily usage (i.e., hours per day) by equipment-specific emission factors and equipment-specific load factors consistent with the ARB's off-road mobile source emission inventory model, OFFROAD. GHG emissions from on-road motor vehicles were estimated using EMFAC2011 mobile source emission factors, which includes emission factors for vehicles in San Diego County. Worker and heavy-duty truck trips were estimated based on data provided in the Traffic Impact Analysis for San Elijo Lagoon Restoration Project (Appendix J). Electricity-related emissions were estimated using SDG&E emissions factors for 2009. Other detailed assumptions are provided in Appendix K.

Consistent with Section 3.11 (Air Quality), this analysis evaluates lagoon restoration and materials disposal together. Climate change and GHG emissions are a cumulative impact and therefore emissions associated with individual project components must be evaluated together. The project may use a diesel or electric engine; therefore, emissions associated with each engine type are evaluated.

CEQA Analysis

Alternative 2A – Proposed Project

Temporary

As shown in Table 3.16-2, construction emissions using a diesel dredge would total 29,177 MT CO_2e over the 36-month construction period, and the maximum emissions in a single year were estimated to be 9,480 MT CO_2e in 2017. With an electric dredge, construction emissions would total 30,266 MT CO_2e over the construction period, and the maximum emissions in a single year are estimated to be 9,813 MT CO_2e in 2017. The annual construction-related GHG emissions would exceed the threshold of 2,500 MT of CO_2e per year. **Therefore, this impact would be a considerable contribution to cumulative climate change (Criterion A).**

Table 3.16-2
Construction-Related Greenhouse Gas Emissions
for Alternative 2A

	Annual Emissions (MT CO2e)							
	2016		**2017**		**2018**		**2019**	
	Diesel	Electric	Diesel	Electric	Diesel	Electric	Diesel	Electric
Mobilization/Demobilization/ Site Preparation	251	251					173	173
Construction Equipment	2,632	2,632	4,806	4,806	4,127	4,127	2,209	2,209
Dredging	2,386	2,564	4,474	4,807	4,589	4,931	3,195	3,433
Materials Disposal	134	134	200	200				
Annual Total	**5,403**	**5,580**	**9,480**	**9,813**	**8,717**	**9,058**	**5,577**	**5,815**
Total Emissions								
Diesel								*29,177*
Electric								*30,266*

[1] Dredging may use either a diesel or electric engine; therefore, both are analyzed in this analysis. Other emissions would be equal.
Source: Modeled by AECOM 2014; for more detail see Appendix K

ARB's Scoping Plan includes measures to meet California's goal of reducing emissions to 1990 levels by 2020 and also reiterates the state's role in the long-term goal established in Executive Order S-3-05, which is to reduce GHG emissions to 80 percent below 1990 levels by 2050. According to ARB, the 2020 goal was established as an achievable, mid-term target, and the 2050 GHG emissions reduction goal represents the level scientists believe is necessary to stabilize the climate (ARB 2008).

ARB's Scoping Plan includes measures that would indirectly address GHG emissions levels associated with construction activities, including the phasing in of cleaner technology for diesel engine fleets (including construction equipment) and the development of a low carbon fuel standard (LCFS). Policies formulated under the mandate of AB 32 that are applicable to construction-related activities are assumed to be implemented during construction of the project.

The measures in the Scoping Plan also put California on a path to meet the long-term 2050 goal of reducing California's GHG emissions to 80 percent below 1990 levels. Implementing light-duty vehicle GHG emission standards, LCFS, regional transportation-related GHG targets, and the Renewable Portfolio Standard (RPS) as set forth in the Scoping Plan would continue to achieve reductions through at least 2030. However, the Scoping Plan does not recommend additional measures for meeting specific GHG emissions limits beyond 2020. The Scoping Plan is currently being updated, and additional information on revised measures is not available at the time this analysis was developed.

The County of San Diego has taken steps to address climate change impacts at a local level. In June 2012, the County adopted a Climate Action Plan (CAP) to address growth and climate change. The CAP quantifies GHG emissions, establishes reduction targets for 2020, and identifies strategies and measures to reduce GHG levels. The emission reduction measures in the CAP address water, energy, land use, transportation, agriculture, and open space. The community-wide GHG emissions inventory for the CAP included estimates for construction activities and off-road vehicles. However, the strategies and measures in the CAP do not address construction-related emissions. The County of San Diego does not have a "standard" list of policies or mitigation measures that would be required for construction projects with potentially significant GHG emissions impacts (County of San Diego 2012). Therefore, the proposed project would not conflict with the County of San Diego CAP.

Neither the County nor any other agency with jurisdiction over the proposed project has adopted climate change or GHG reduction measures with which the proposed project would conflict. Therefore, the proposed project would not conflict with existing plans, policies, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

Permanent

As noted above, maintenance activities would occur every 3 years and would include dredging, construction equipment, and worker vehicle trips. As shown in Table 3.16-3, the emissions associated with regular maintenance using a diesel-engine dredge were estimated at 3,686 MT CO_2e, which amortized over a 3-year period would result in an annual operational emissions of 1,229 MT CO_2e per year. For an electric-engine dredge, regular maintenance would result in 3,856 MT CO_2e, or approximately 1,285 MT CO_2e per year amortized over a 3-year period.

Table 3.16-3
Maintenance-Related Greenhouse Gas Emissions
for Alternative 2A

	Maintenance Emissions ($MT\ CO_2e$)	
	Diesel	Electric
Construction Equipment	1,398	1,398
Dredging	2,288	2,458
Total Emissions	**3,686**	**3,856**

[1] Dredging may use either a diesel or electric engine; therefore, both are analyzed in this analysis. Other emissions would be equal.
Source: Modeled by AECOM 2014; for more detail see Appendix K

State and federal programs would result in the reduction of GHG emissions, especially for operational emissions that would occur after the initial construction period. Existing programs for air quality improvement in California, including the Diesel Risk Reduction Plan and the 2007 SIP, would result in the accelerated phase-in of cleaner technology for virtually all of California's diesel engine fleets, including construction equipment (ARB 2008). The NHTSA fuel economy standards for medium- and heavy-duty engines will lower emissions for engines of model years 2014 and later. Measures implemented under these plans are likely to result in more GHG efficient off-road construction equipment and on-road vehicles.

If an electric engine is used for dredging, emissions associated with the use of electricity would be reduced from continued implementation of the RPS. The source of electricity (e.g., renewable energy) affects the amount of GHG emission estimates associated with the proposed project. Electricity-based emissions account for approximately 50 percent of construction emissions and 65 percent of maintenance emissions under the electric dredge scenario; therefore, depending on the pace of implementation of the RPS by SDG&E, fewer emissions may result from use of an electric dredge than reported above.

However, additional reductions associated with state and federal programs were not included in the estimates of GHG emissions. The total annual operational GHG emissions would exceed the threshold of 2,500 MT of CO_2e per year. **Therefore, the impact would be a considerable contribution to cumulative climate change (Criterion A).**

As discussed earlier, ARB's Scoping Plan includes measures that would indirectly address GHG emissions levels associated with construction activities, including the phasing in of cleaner technology for diesel engine fleets (including construction equipment) and the development of an LCFS. Policies formulated by ARB under the mandate of AB 32 that are applicable to construction-related activities are required for projects and are therefore assumed to be implemented during maintenance and operational activities.

The emission reduction measures in the County of San Diego CAP address water, energy, land use, transportation, agriculture, and open space. The community-wide GHG emissions inventory for the CAP included estimates for construction activities and off-road vehicles. However, the strategies and measures in the CAP do not address construction-related emissions. Therefore, the proposed project would not conflict with the County of San Diego CAP.

Neither the County nor any other agency with jurisdiction over the proposed project has adopted climate change or GHG reduction measures with which the proposed project would conflict. Therefore, the operational and maintenance activities for the proposed project would not conflict with existing plans, policies, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

Alternative 1B

Temporary

As shown in Table 3.16-4, construction emissions under Alternative 1B using a diesel dredge would total 28,090 MT CO_2e over the proposed construction period, and the maximum emissions in a single year are estimated to be 9,076 MT CO_2e in 2017. Total construction emissions with an electric dredge would result in 29,178 MT CO_2e over the construction period. The annual construction GHG emissions would exceed the threshold of 2,500 MT of CO_2e per year. **Therefore, the impact would be a considerable contribution to cumulative climate change (Criterion A).**

Table 3.16-4
Construction-Related Greenhouse Gas Emissions for Alternative 1B

	Annual Emissions (MT CO2e)							
	2016		**2017**		**2018**		**2019**	
	Diesel	Electric	Diesel	Electric	Diesel	Electric	Diesel	Electric
Mobilization/Demobilization/ Site Preparation	251	251					173	173
Construction Equipment	2,447	2,447	4,401	4,401	3,575	3,575	2,264	2,264
Dredging	2,386	2,564	4,474	4,807	4,589	4,931	3,195	3,433
Materials Disposal	134	134	200	200				
Annual Total	**5,218**	**5,396**	**9,076**	**9,408**	**8,164**	**8,505**	**5,632**	**5,869**
Total Emissions								
Diesel								*28,090*
Electric								*29,178*

Source: Modeled by AECOM 2014; for more detail see Appendix K

Similar to Alternative 2A, construction activities associated with Alternative 1B would not conflict with ARB's Scoping Plan and the County of San Diego CAP. Therefore, Alternative 1B would not conflict with existing policies, plans, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

Permanent

Maintenance activities under Alternative 1B would occur annually and would include construction equipment and worker vehicle trips. However, Alternative 1B would not require use of a dredge. As shown in Table 3.16-5, emissions would total 106 MT CO_2e every year. The total annual operational GHG emissions would be less than the threshold of 2,500 MT of CO_2e per year. Therefore, **this impact would not be a considerable contribution to cumulative climate change (Criterion A).**

Table 3.16-5
Maintenance-Related Greenhouse Gas Emissions for Alternative 1B

	Maintenance Emissions (MT CO_2e/yr)
Construction Equipment	106
Total Annual Emissions	**106**

Notes: MT CO_2e/yr = metric tons of carbon dioxide equivalent per year.
Source: Modeled by AECOM 2014; for more detail see Appendix K

Similar to Alternative 2A, the operational and maintenance activities associated with Alternative 1B would not conflict with ARB's Scoping Plan and the County of San Diego CAP. Therefore, operational and maintenance activities associated with Alternative 1B would not conflict with existing policies, plans, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

<u>Alternative 1A</u>

Temporary

As shown in Table 3.16-6, construction emissions over the 3-year period under Alternative 1A would total 9,670 MT CO_2e using a diesel dredge and 9,822 MT CO_2e with an electric dredge. The annual construction GHG emissions in 2016 and 2017 would exceed the threshold of 2,500 MT of CO_2e per year. **Therefore, the impact would be a considerable contribution to cumulative climate change (Criterion A).**

Table 3.16-6
Construction-Related Greenhouse Gas Emissions for Alternative 1A

	2016		**2017**		**2018**	
	Diesel	Electric	Diesel	Electric	Diesel	Electric
Mobilization/Demobilization/ Site Preparation	251	251	251	251	173	173
Construction Equipment	2,563	2,563	2,563	2,563	994	994
Dredging	809	869	809	869	404	434
Materials Disposal	342	342	342	342	171	171
Annual Total	**3,964**	**4,025**	**3,964**	**4,025**	**1,742**	**1,772**
Total Emissions						
Diesel						*9,670*
Electric						*9,822*
Amortized Emissions						
Diesel						*484*
Electric						*491*

[1] Dredging may use either a diesel or electric engine; therefore, both are analyzed in this analysis. Other emissions would be equal.
Source: Modeled by AECOM 2014; for more detail see Appendix K

Similar to Alternative 2A, the construction activities associated with Alternative 1A would not conflict with ARB's Scoping Plan and the County of San Diego CAP. Therefore, Alternative 1A would not conflict with existing policies, plans, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

Permanent

Minimal annual maintenance would occur under Alternative 1A and would include construction equipment and worker vehicle trips. Alternative 1A would not require use of a dredge. As shown in Table 3.16-7, operational GHG emissions would total 92 MT CO_2e per year. The total annual operational GHG emissions would be less than the threshold of 2,500 MT of CO_2e per year. Therefore, **this impact would not be a considerable contribution to cumulative climate change (Criterion A).**

Table 3.16-7
Maintenance-Related Greenhouse Gas Emissions for Alternative 1A

	Maintenance Emissions (MT CO_2e/yr)
Construction Equipment	92
Total Annual Emissions	**92**

Notes: MT CO_2e = metric tons of carbon dioxide equivalent.
Source: Modeled by AECOM 2014; for more detail see Appendix K

Similar to Alternative 2A, the operational and maintenance activities associated with Alternative 1A would not conflict with ARB's Scoping Plan and the County of San Diego CAP. Therefore, operational and maintenance activities associated with Alternative 1A would not conflict with existing policies, plans, or regulations adopted for the purpose of reducing GHG emissions. **This impact would be less than cumulatively significant (Criterion B).**

No Project/No Federal Action Alternative

The No Project/No Federal Action Alternative would result in continued periodic maintenance at the project site and would therefore result in continued periodic GHG emissions. Under this alternative, no dredging or excavation would occur to improve tidal circulation, channel clearing, or other comprehensive actions to improve tidal exchange or upstream flooding. The lagoon inlet would remain in its existing location. However, maintenance is intermittent and dependent on funding. The No Project/No Federal Action Alternative would result in continued vehicular and equipment activity primarily related to maintenance of the inlet opening. Since no increase in activities would occur under the No Project/No Federal Action Alternative, GHG emissions would also not increase. Due to improved emission standards, emissions would be anticipated to be lower in future years. Therefore, **this impact would not be a considerable contribution to cumulative climate change and would be less than significant (Criteria A and B).**

NEPA Analysis

None of the alternatives analyzed would emit more than 25,000 MT CO_2e per year. According to CEQ guidance, no further analysis is required. Therefore, **no substantial adverse direct or indirect effects would occur.**

Sea Level Rise and Extreme Events

Lagoon Restoration

San Elijo Lagoon will be subject to climate change regardless of the alternative implemented. Vulnerabilities would be based on changes in temperature, precipitation (timing and amount), drought, storm intensity, extreme heat days, sea level rise, and storm surges. In general, increased sea level could allow high tides to reach farther into low-lying areas; flooding could persist longer and be more difficult to drain; higher water levels may cause greater erosion; and prolonged drought may affect species survival.

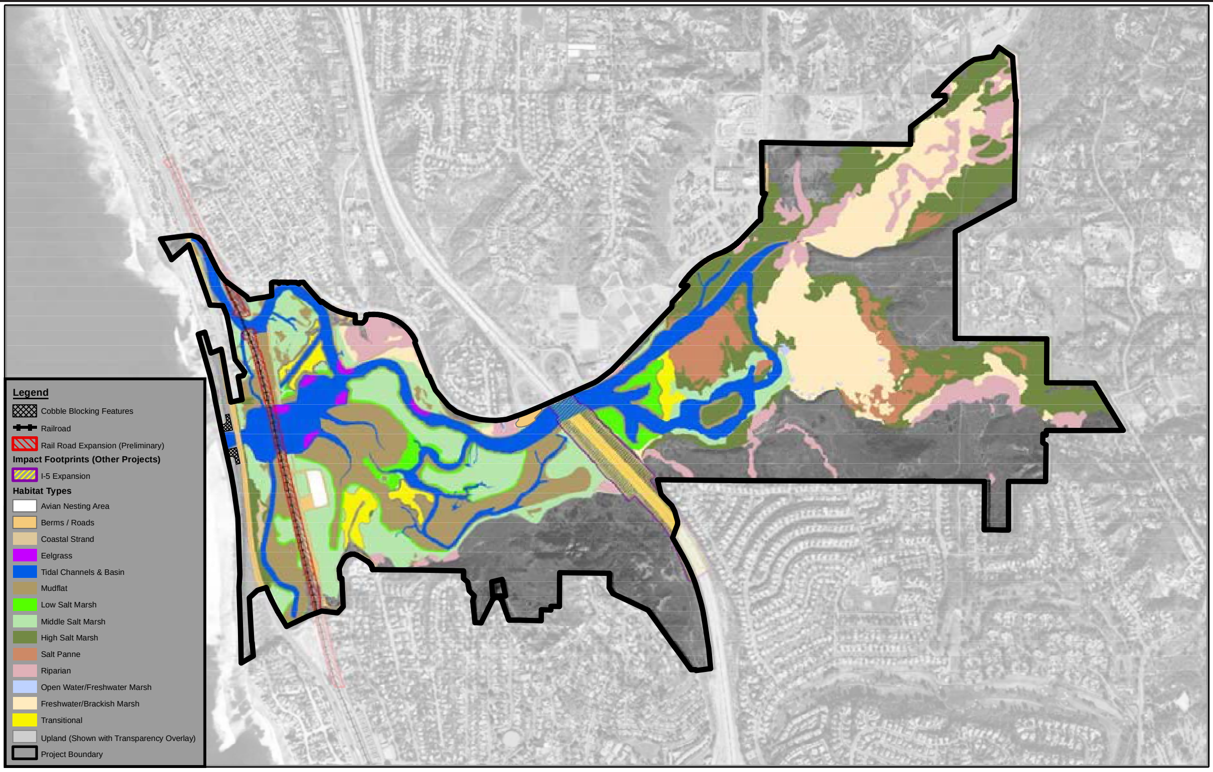
The regional climatic and physical characteristics subject the lagoon to many of the changes that are anticipated. The lagoon is often inundated due to the lack of a fully functional inlet. The effects of inundation would be similar to those caused by flooding or sea level rise. Extreme temperatures and drought also occur in the lagoon and while their frequency may increase due to climate change, much of the existing flora and fauna is adapted to fluctuations in their environment. The ocean would moderate extreme temperature changes to some extent. Species within the lagoon are expected to be resilient to short periods (days to weeks) of extreme heat or cold, because these species are already subjected to these periodic conditions (e.g., Santa Ana conditions) and a slight increase in frequency is unlikely to result in major biota losses.

Projected sea level rise scenarios as discussed in Section 3.16.1 and the *Sea Level Rise Analysis* prepared for the project (M&N 2010) guided the restoration planning and engineering for the proposed project. The restoration plan includes areas of higher elevation (e.g., man-made transitional areas) that are intended by design to transition from upland to wetland under sea level rise, or from a higher elevation wetland to a lower elevation. Additionally, the lagoon currently has existing areas outside of tidal influence that are anticipated to convert to tidally influenced wetland as sea level rise occurs (e.g., upland slopes surrounding lagoon and freshwater/brackish wetland areas within the east basin). Additional adaptive capacity would depend on the alternative chosen and the adaptive management plan. Ongoing maintenance activities are anticipated for each alternative and would be guided by the management plan. That management plan would address specific risks and uncertainties, including those related to climate change. The plan would include feasible adaptation strategies that can be implemented as risks are identified. This would include establishing indicator data that would be monitored regularly, such as the ordinary high water mark; and minimizing loss by allowing habitat migration or redistributing dredged sediment to raise elevations, as necessary.

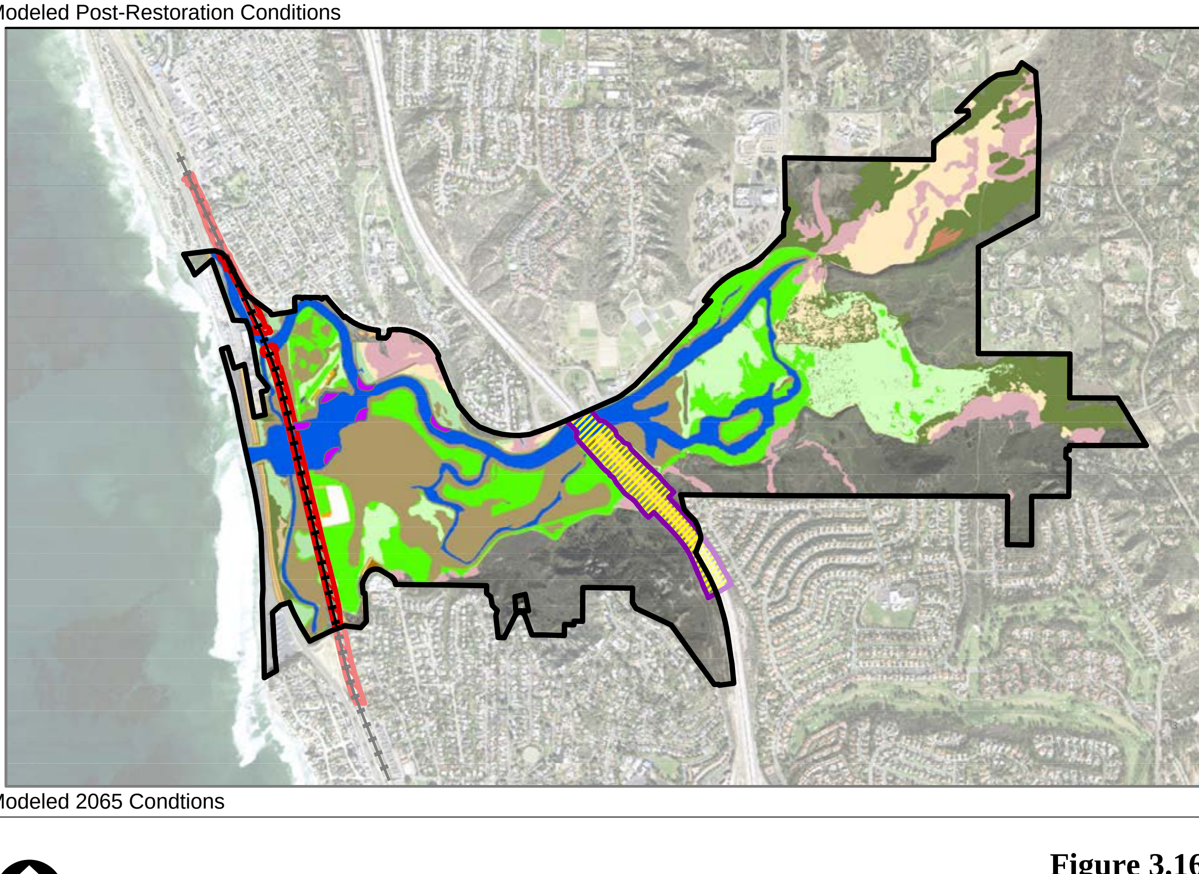
Alternative 2A

Alternative 2A would restore the tidal range within the lagoon to be more consistent with that of the ocean (Table 3.2-1) and lower the maximum 100-year flood elevation (Table 3.2-2). The tidal range would increase over existing conditions and habitats would be restored to support a diverse mix of critical species. Figure 3.16-2 illustrates the generalized habitat distribution change over time (from existing conditions to 2065) with sea level rise.

Maintaining a consistent tidal exchange with the ocean would enhance the ability of the lagoon to slowly adapt to changes in sea level over time. Lowered flood elevation would provide resiliency against floods, other extreme events, and sea level rise. Although, under extreme sea level increases, the lagoon may be inundated, Alternative 2A would include an adaptive management plan identifying strategies that could provide additional habitat by selectively redistributing sediment to maintain habitats or facilitate relocation of habitats to higher elevations. In addition, maintaining healthy wetlands protects shorelines from flood and erosion



Modeled Post-Restoration Conditions



Modeled 2065 Condtions

Figure 3.16-2
Alternative 2A Generalized Habitat Distribution With Sea Level Rise

by absorbing waves and slowing the flow of the high water mark. Overall, Alternative 2A would improve the ability of the project area to respond to long-term climate impacts, such as increased sea level rise.

Alternative 1B

Similar to Alternative 2A, Alternative 1B would increase the tidal range within the lagoon and generally reduce the maximum flood elevation of the lagoon, although not to the same extent as Alternative 2A. Figure 3.16-3 illustrates the generalized habitat distribution change over time (from existing conditions to 2065) with sea level rise. Maintenance activities would occur annually, providing additional opportunity to respond to long-term climate change impacts.

Alternative 1A

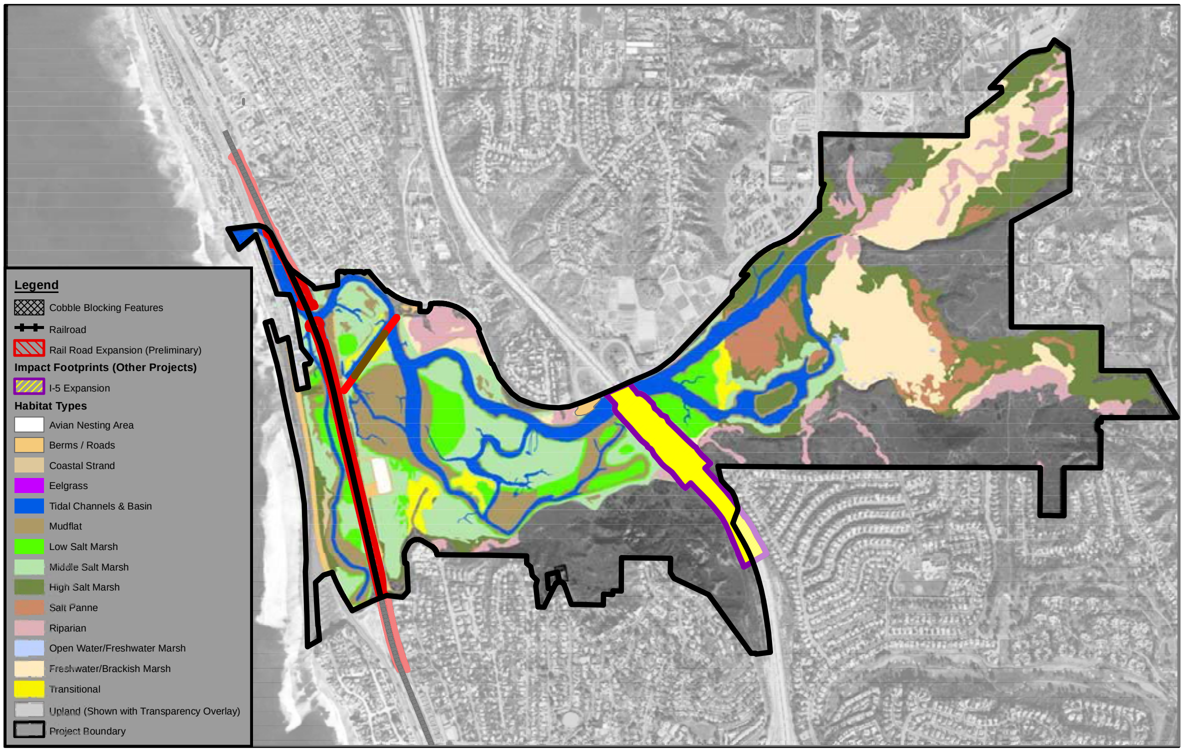
Alternative 1A would provide better tidal exchange between the lagoon and ocean, increasing tidal range in the lagoon and enhancing its ability to respond slowly to changes in sea level, although likely not to the same extent as Alternative 1B or Alternative 2A. Figure 3.16-4 illustrates the generalized habitat distribution change over time (from existing conditions to 2065) with sea level rise. The flood elevation would improve in some areas but decline in the east basin. The lagoon would benefit from continued opening of the existing inlet and annual maintenance, allowing additional opportunity to respond to long-term climate change impacts.

No Project/No Federal Action Alternative

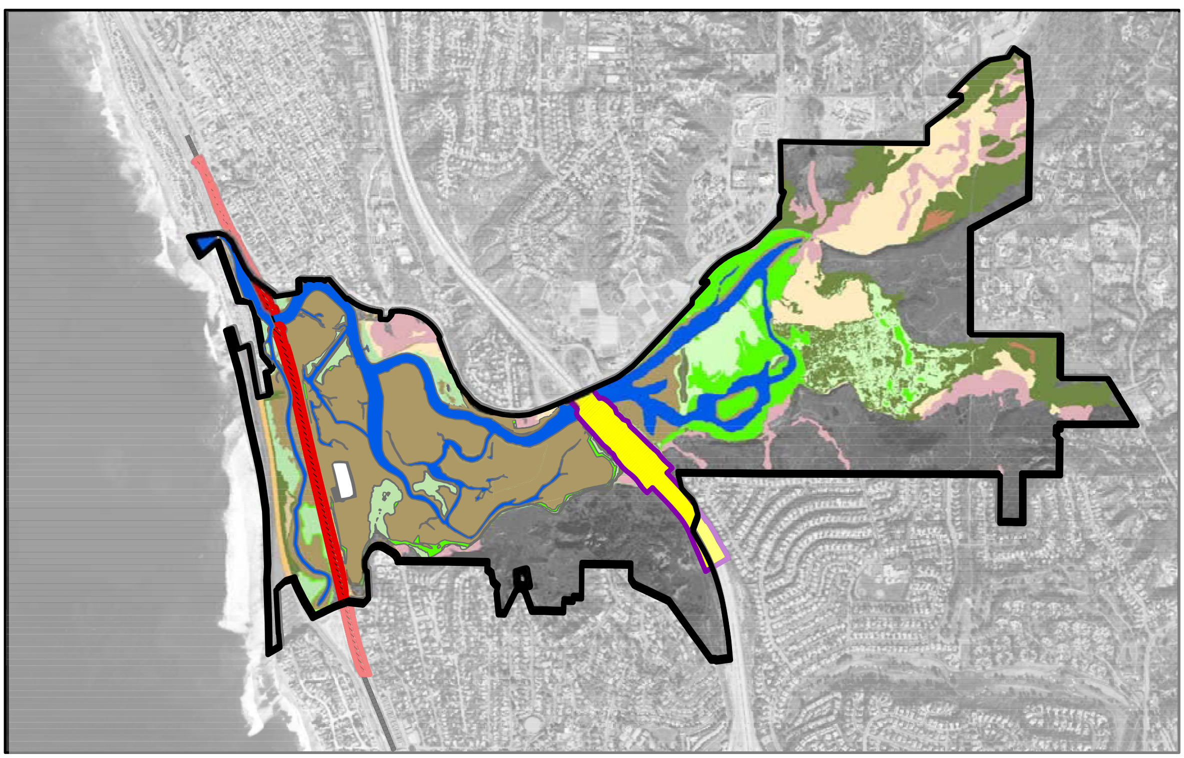
The lagoon would function similar to current conditions under a No Project/No Federal Action Alternative. As shown in Figures 3.16-1 and 3.16-5, sea level rise would affect water levels and habitat distribution in the project area. The lagoon would continue to be inundated with freshwater from the east and have limited capacity to drain the water through flow to the ocean, converting the lagoon to open water habitat. Conversely, tidal ranges consistent with the ocean would not be maintained and would not provide a buffer to storm surges or flood events. Critical habitats could shift to freshwater habitats or more subtidal habitats, depending on drainage within the lagoon.

Materials Disposal/Reuse

The vast majority of material from the restoration project would be placed either offshore, nearshore, or onshore depending upon the alternative in the very near term (2016 or 2017), which is well before extreme sea level rise or extreme events associated with climate change would be noticeable. However, it is possible that increased beach widths from onshore placement

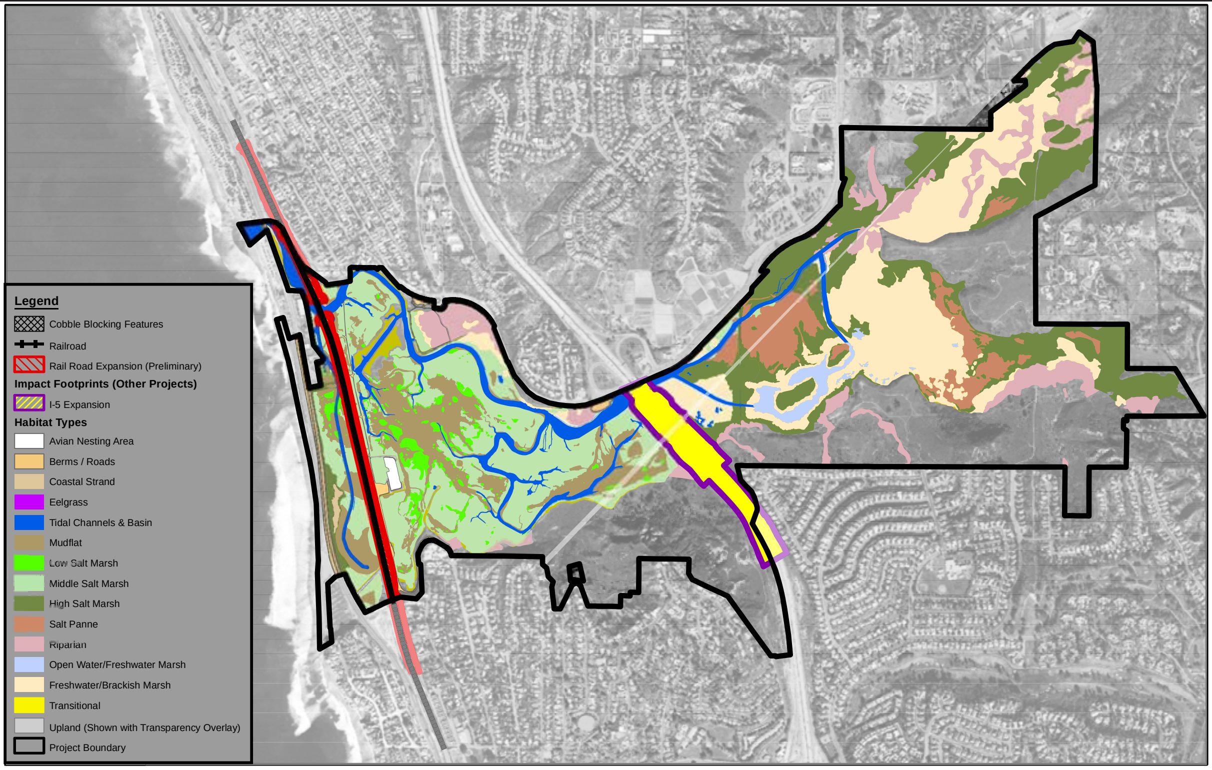


Modeled Post-Restoration Conditions

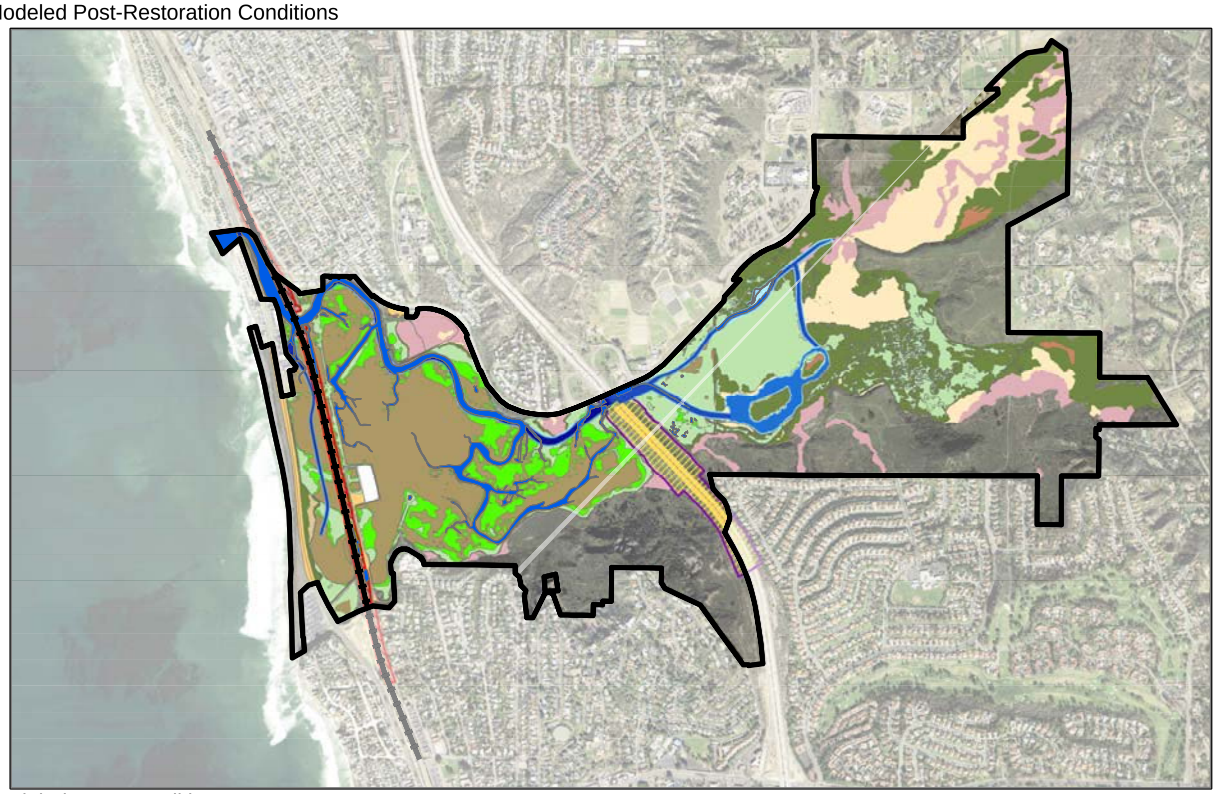


Modeled 2065 Condtions

Figure 3.16-3
Alternative 1B Generalized Habitat Distribution With Sea Level Rise



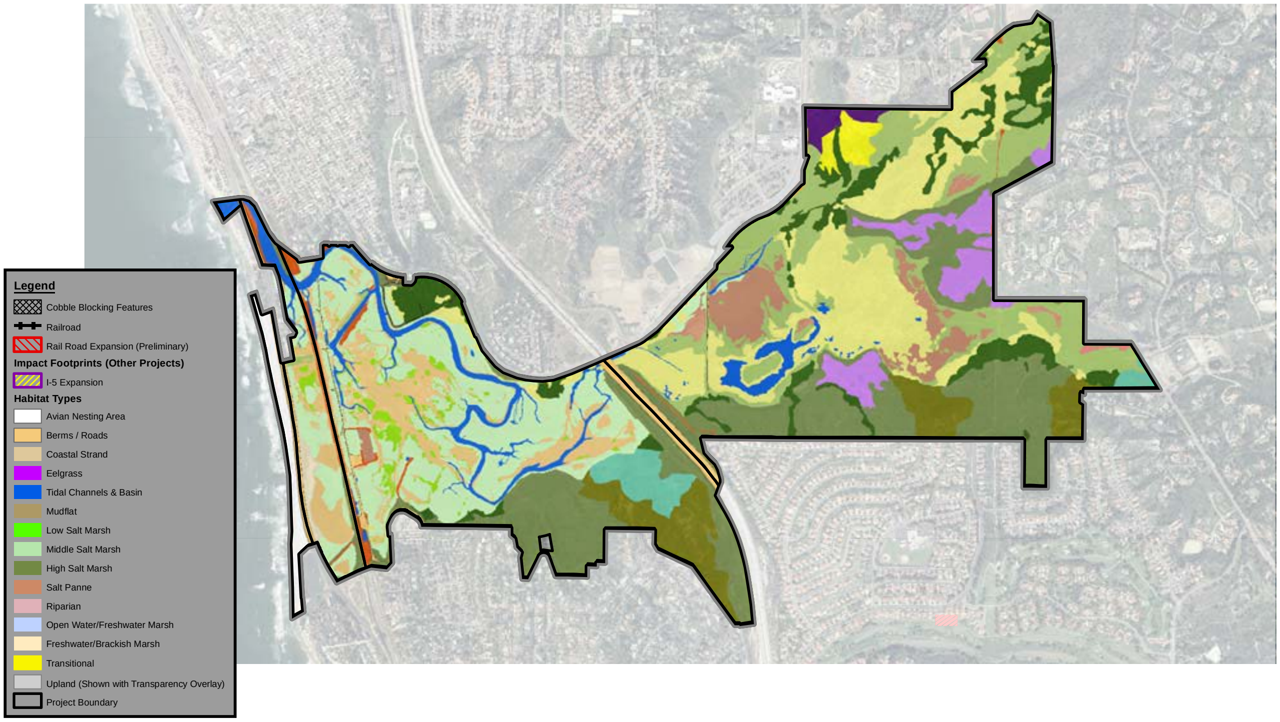
Modeled Post-Restoration Conditions



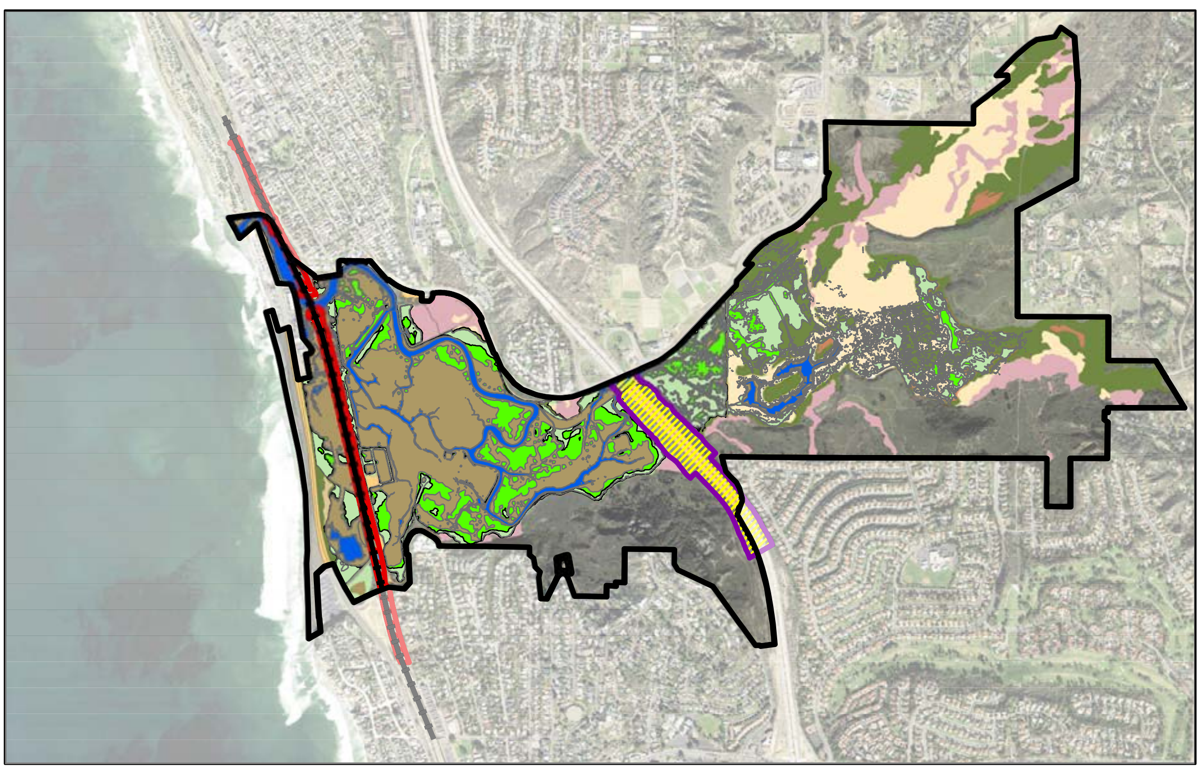
Modeled 2065 Conditions

Figure 3.16-4
Alternative 1A Generalized Habitat Distribution With Sea Level Rise

Path: P:\2008\08080046 San Elijo Lagoon Gap Analysis\5GIS\MXD\Alternatives_Development_Report\alt2a.ai dbrady 2/25/13



Existing Conditions (2012)



Modeled 2065 Conditions

Figure 3.16-5
No Project Generalized Habitat Distribution With Sea Level Rise

could provide temporary localized protection for structures on top of eroding bluffs, or infrastructure close to sea level and subject to ocean action, placed material is anticipated to disperse throughout the littoral cell and the volume of sand added to the entire littoral system from this one event would not be large enough to be noticeable over time. Materials placement associated with periodic inlet maintenance (30,000 to 300,000 cy) would also provide localized temporary benefits.

3.16.4 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

Construction-related and operational GHG emissions for Alternative 2A would exceed the recommended level of significance. Construction-related GHG emissions for Alternative 1B and Alternative 1A would exceed the recommended level of significance. Project design features would be incorporated related to equipment maintenance and idling time to reduce GHG emissions associated with the project alternatives. Mitigation Measures AQ-1 through AQ-3 could also result in a reduction in GHG emissions. The following measures are also recommended to reduce GHG emissions:

GHG-1 On-site material hauling shall be performed with trucks equipped with on-road engines to the extent practicable.

GHG-2 Limit deliveries of materials and equipment to the site to off-peak traffic congestion hours to the extent practicable.

GHG-3 Restrict material hauling on public roadways to off-peak traffic congestion hours to the extent possible. During construction scheduling and execution minimize, to the extent possible, uses of public roadways that would increase traffic congestion.

GHG-4 Use high-efficiency lighting and Energy Star-compliant heating and cooling units. Implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business.

No additional feasible mitigation has been identified for GHG emissions from construction or operational activities.

3.16.5 LEVEL OF IMPACT AFTER MITIGATION

CEQA: Based on the level of construction activities anticipated with each project alternative, even with implementation of Mitigation Measures GHG-1 through GHG-4, construction emissions would continue to exceed the threshold of 2,500 MT CO_2e per year. This impact would be a considerable contribution to cumulative climate change and would remain significant and unavoidable.

NEPA: The estimated emissions for all project alternatives would not exceed the CEQ emission thresholds. Therefore, no substantial adverse direct or indirect effects would occur.

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